Meteorological Analysis of MAPS First Shuttle Flight

Final Technical Report

on

NASA Research Grant NAG-1-292

(NASA-CR-169739) METEOROLOGICAL ANALYSIS OF MAPS FIRST SHUTTLE FLIGHT Final Technical Report (Massachusetts Inst. of Tech.) 5 p HC A02/MF A01 CSCL 14B

N83-15600

Unclas G3/35 02407

Dr. Mark Doherty
Professor Reginald E. Newell
Department of Meteorology and Physical Oceanography
Massachusetts Institute of Technology
Cambridge, Massachusetts 02139

Submitted To:

NASA Technical Officer
Dr. H.G. Reichle
Mail Stop 401A
NASA
Langley Research Center
Hampton, VA 22665

January 11, 1983

During this study we have commenced an analysis of the data from the MAPS radiometer launched on board the first shuttle flight on 12 November, 1981. Our main objective has been to analyze the meteorological data relevant to the MAPS measurements so that the in situ calibration measurements and any anomalous features within the data set may be evaluated in the context of the atmospheric circulation during the period of observation. We planned to utilize the three-dimensioned isentropic analysis scheme developed by Ed Danielsen as the main analytical tool in this program.

We have acquired the NMC-NCC Asheville analysis of the global radiosonde network for the period November 8-14, 1981 from Dr. Reichle's group at Langley. In addition, Dr. Reichle's group has provided us with graphical output of the N and Δ channel signals, black body reference temperatures, reduced CO concentrations and ground tracks for orbits 15 and 16. (Orbit 15 was published by Reichle et al in Science 218, December 3, 1982.)

Much of our effort has been devoted to studying the isentropic trajectory methods since it is a basic requirement for this work that the analysis be extended to incorporate daily data within the tropics. To date, Dr. Danielsen's method has utilized only climatological data in tropical latitudes and we judge that the mixing of CO-poor southern hemispheric air and CO-rich northern hemispheric air with these latitudes contributes significantly to latitudinal, longitudinal and time variations of the CO field. Therefore, we must study trajectories within the tropics.

From our discussions with Dr. Danielsen, we have learned that at these latitudes, the NMC analysis with which we had planned originally to begin the study, contain temperature errors of a magnitude greater than

the accuracy limits which can be tolerated by the trajectory scheme. At present, Dr. Danielsen is developing a new method of analyzing the raw radiosonde data which should result in gridded fields of sufficient accuracy to permit satisfactory trajectory analysis.

Figures 1-4 taken from Linder (Weather, 37, p. 166, 1982) illustrate the intense storm that developed off the N. American West Coast during the flight. A low pressure of 958 mb was reached, this being very unusual for a storm south of 40°N, occuring at most once every 20 years. The NMC forecast completely missed this development and it seems that the reason may have been significant transfer of air of very high potential vorticity from the stratosphere to the troposphere (E. Danielsen, private communication). This transfer was revealed by the low CO values in the upper troposphere in the calibration flight of the CV-990 out from Ames. This case illustrates that the interpretation of the MAPS data will depend quite strongly on a fairly detailed potential vorticity analysis which in turn will have to proceed from actual radiosonde data rather than from smoothed analysis. Just as the use of the NMC smoothed data caused the storm development to be missed, so also would it lead to incomplete interpretations of the MAPS data.

Further work aimed at a unified approach to the radiometric and meteorological data on a global basis must be delayed until the laboratory calibrations of the MAPS radiometer have been completed and the final reduced CO concentrations are available. It seems probable that by this time, the new analysis scheme being worked on by Dr. Danielsen will be operational and a full study of the CO field and global trajectories can be executed as originally proposed.

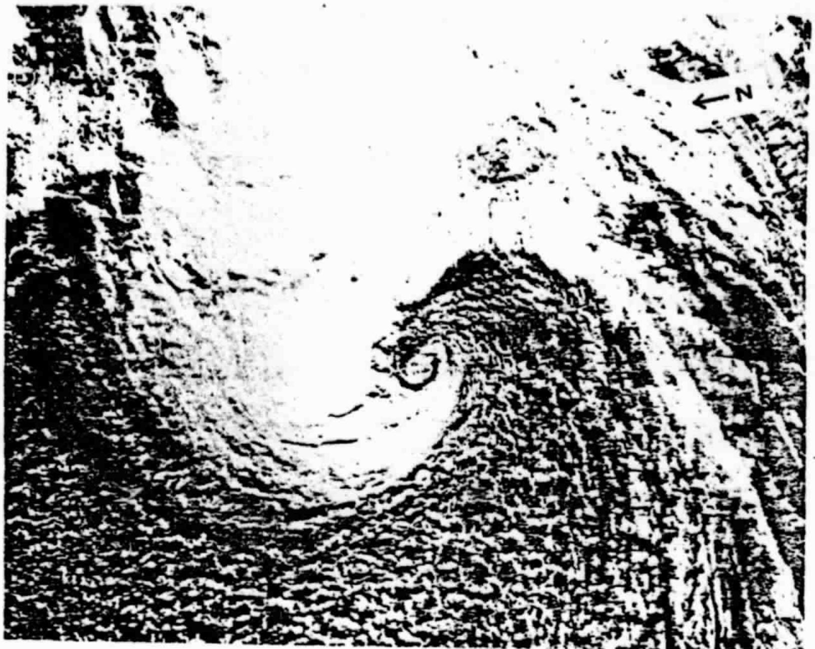

Fig. 1 NOAA–6 visible picture, 1655 GMT 13 November 1981

Fig. 2 NOAA–6 enhanced infra-red picture, 1655 GMT 13 November 1981

ORIGINAL PAGE IS
OF POOR QUALITY

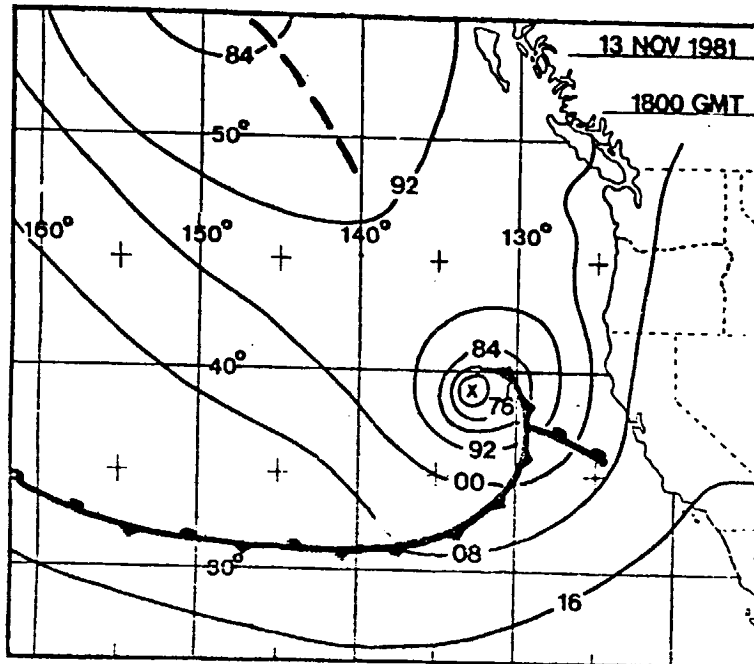

Fig. 3 Mean sea level pressure map, 1800 GMT 13 November 1981. The 'x' marks the storm centre with central pressure of 958 mb

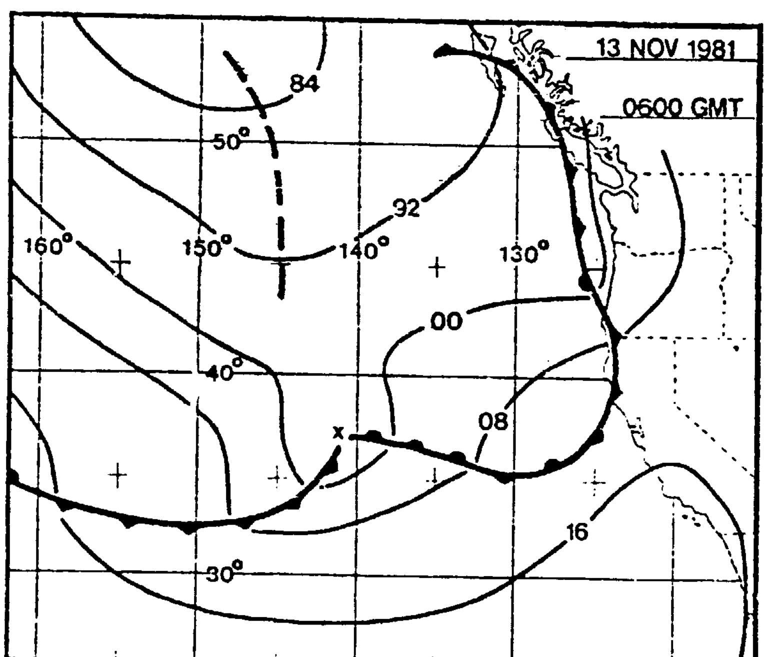

Fig. 4 Mean sea level pressure map, 0600 GMT 13 November 1981. The 'x' marks the storm centre with central pressure of 992 mb